Electricity (Gas) Basic Electricity

Movement of electron

When the application of a force to a material causes the electrons of that material to move from one atom to another, the result is a flow of negative electrical charges; or, stated in different words, an electric current is the flow or movement of electrons from one atom to another.

Diameter

If two wires are the same material and length, the thinner wire will have more resistance than the thicker wire.

Electrons in motion are constantly colliding as voltage pushes them through a conductor.

Ohm's Law Ohm's Law states: The current in a circuit is directly proportional to the applied voltage and inversely proportional to the amount of resistance. This means that if the voltage goes up, the current goes up. If the resistance goes up, the current goes down.

Semiconductor materials include the elements silicon and germanium, and the compounds gallium arsenide, lead sulfide, or indium phosphide. There are many other semiconductors, even certain plastics can be made semiconducting, allowing for plastic light-emitting diodes (LEDs) which are flexible,

Silver, copper, gold, and aluminum all contain one valence electron and are excellent conductors of electricity. Silver is the best natural conductor of electricity, followed by copper, gold, and aluminum

They contain four valence electrons and are characterized by the fact that as they are heated, their resistance decreases. Heat has the opposite effect on conductors, whose resistance increases with an increase of temperature

Amps come from the elctron. Big the conductor more amps you have

Voltage (or volts) is the term used to describe electrical pressure. The source of Electromotive Force (EMF) is used to create a difference in potential (or voltage) between two points in the circuit

Resistance opposes current flow. It is like electrical "friction". This resistance slows the flow of current. Every electrical component or circuit has resistance, including the conductors. Copper is a good conductor. Iron, aluminum, silver, gold and many other metals, are all conductors of electricity

the greatest amount of resistance in an electrical circuit is encountered when electrical energy is converted to heat, light or magnetism and is referred to as an electrical "Load"

In most conductors, resistance increases as the wire temperature increases. Electrons move faster, but not necessarily in the right direction as the atoms are further apart. Most insulators and semiconductors have less resistance as the temperature increases.

Ohm's Law is usually stated or written as:

Intensity of Current = Electromotive Force (EMF) Resistance or Amps = Volts Ohms Or in standard symbol form: **I = E /R** Now, by using simple algebra we can derive two other forms of this same formula: **E = I × R** The current multiplied by the resistance is equal to the voltage difference (or drop) across the resistance. **R = E/ I**

POWER (WATTS)= E(VOLT) multipy (AMPS) I

Why does the electron remain in its orbit and not be pulled into the nucleus?

Centrifugal force

What is the name given to an atom with an unbalanced electrical charge?

Ion

Which unit of measure is used to describe “Electromotive Force”?

Voltage

If the voltage is constant, but the resistance of the circuit is doubled, what would be the effect to current flow?

It would be reduced by one half

Calculate the current through a circuit if it has 50 ohms of resistance and the voltage drop is 24 volts?

Your answer is incorrect.

I=ERI=E /R
I=24V50ΩI=24V/50Ω
I = 0.48 A

The correct answer is: 0.48 A

Calculate the milli-voltage drop through a circuit if it has 1.5 ohms of resistance and the current flow is 0.25 amps?

Your answer is correct.

E = I x R

E = 0.25 A x 1.5 ohm

E = 0.375 v or 375 mV

The correct answer is: 375

What would be the anticipated resistance of a circuit with an EMF of 120 volts and a current of 6 amps?

Your answer is correct.

R=EI$R=E/I$
R=120V/6A$R=120V//6A$
R = 20 ohms

The correct answer is: 20 ohm

Electricity (Gas) Generating Electricity

If heat is applied to two dissimilar metals or alloys that are joined together, electrons are transferred across the junction, resulting in current flow. This is known as the “Seebeck (or Thermoelectric) Effect” named

Thermocouples are used for two practical applications; to generate electricity for extra low voltage circuits and to act as temperature sensors. Thermocouples used to supply voltage to combustion safety circuits are heated by a pilot burner and can produce 20 to 30 milli-volts. See Figure below. It is important that only 3/8 to 1/2 inch (9 to 13 mm) of the thermocouple tip (hot junction) be inserted into the pilot flame in order to generate the greatest amount of electricity

If thermocouples are designed to act as temperature sensors, the voltage being created by the thermocouple due to heat can then be interpreted using thermocouple reference tables to calculate the temperature at the hot junction

Chemical Reaction (or Electrochemistry)

Pressure (Piezoelectricity)

The piezoelectric effect occurs when the charge balance within a material’s crystal structure is disturbed. When there is no applied stress on the material, the positive and negative charges are evenly distributed so there is no potential difference. When force is applied, the material’s structure changes slightly, the charge imbalance creates a potential difference, often as high as several thousand volts.

vThe important thing is that there is motion within the magnetic field, and that the wire cuts through the magnetic lines of force. Either the conductor in the magnetic field or the magnetic field itself must be in motion. See Figure below. Current flow is the combined result of the magnetic field and motion. This process is called “Electromagnetic Induction”.

Light (or Photoelectricity) “Photo” means light, so Photoelectricity simply means electricity produced by a beam of light. (materials such as silicon that generate an electric current when sunlight shines on them). Photoelectricity is about light (not only visible, but also infrared and ultraviolet) energy being converted into electrical energy and it happens in three different ways known as the photoconductive, photoemissive and photovoltaic effects.

Photoconductive Cell Photoconductive cells are light-sensitive semiconductors in which the resistance decreases with an increase in light intensity (Figure below). Most commercially available photoconductive cells are manufactured from cadmium sulfide (CdS)

Photoemissive Cells Photoemissive cells (or phototubes) is the oldest method of turning light into electricity. They are sealed glass vacuum tubes, inside is a metal plate (usually a cesium alloy) that serves as a negative terminal (or cathode) and a positively charged metal rod (or anode). Incoming photons (light energy) strike the cathode, generating electrons, which are attracted to the anode. Thus current flow is dependent on the frequency and intensity of the incoming photons. The current that flows through the device is typically a few microamperes.

Photovoltaic Cells Like miniature power plants, photovoltaic cells are designed to produce steady supplies of useful, electric power. From small solar cells on electronic calculators to completely photovoltaic roofs, their job is essentially to produce a constant supply of electricity that we can use to power electric appliances or store in batteries for later use. Photovoltaic cells are similar to diodes in that they are made from two layers of semiconductor material placed one on top of another.

The earliest photovoltaic cells converted approximately 1% – 2% of sunlight energy into electrical energy. Today’s devices can convert 7% – 17% of light energy into electric energy

Transformers Transformers are electrical devices that use the principles of magnetism to change AC current from one voltage to another. For example, electricity supplied to a single-family dwelling by the electrical utility is 120 volts, but can be changed to 24 volts for the heating control circuit, or into 6,000 volts for spark ignition.

Induction involves two basic principles: 1. A magnetic field (or flux) surrounds a wire when it is conducting electricity. 2. If another wire or conductor is placed in the magnetic field, electricity will be generated in this conductor.

Some transformers have multiple connections (or tappings) on the primary and/or secondary side. These tappings allow the transformer to be used in a number of different applications with a variety of input or primary voltages to achieve the desired secondary voltage, depending on which tappings are used.

Solution: VA (Watts) = Volts × Amps VA = 24

Volts × (0.2A + 0.8A + 0.3A)

VA = 24 Volts × 1.3A

VA = 31.2

Transformer Phasing Phase can be described as the difference in electrical degrees between two waveforms. An AC sine wave will indicate the polarity of the current flow at any specific time. Referring to figure below, the polarity at the top of the sine wave is 120 volts positive and at the bottom 120 volts negative.

Electricity (Gas) Electrical Circuits

An electrical circuit will typically contain all of the following components:

- power source or electromotive force (EMF) • conductor • load • switch

Conductor For current to flow, a complete circuit must be in place between the terminals of the power source, switches and loads. An electrical conductor is a material that accommodates movement of charged particles, or electrons. T

Copper is commonly used for conductor wire as it has a high conductivity. Silver is more conductive, but is not practical in most cases, due to cost. Aluminum is sometimes used as a conductor. However it is only about 60% as conductive as copper, requiring larger gauge wiring

Load The load in a circuit is the power requirement of any device or equipment that converts electrical energy into light, heat or mechanical energy or otherwise consumes electricity to perform work

Switch A switch is a device to make or break (close or open) an electrical circuit. It is a necessary component designed to interrupt the flow of current to the loads on the circuit, or to divert it from one conductor to another

Series circuit

Figure 5 - Voltage Drop in a Series Circuit

1. Total resistance of the circuit is 150 Ω = 10 Ω + 100 Ω + 40 Ω 1
2. Total voltage drop of the circuit is 120 V = 8 V + 80 V + 32 V
3. Total current flow of the circuit is 0.8 A = 120 V 150 Ω

Paraller circuit

1 divide I=E divide R then added them together at and divide by volgate like 24v or 120v
2 then divide by like 120 or 24v ex 120 divide 22 amp

Culcator total resistance without amp
1 RTotal/ 1/ R1 + 1 /R2 + 1/ R3
Getting ressitence without amp

Then divivde by votage with resistance ex 120/2.94 R

Series-Parallel Circuits

Votage drop after parallel circuits and series circuits

E= I multi by R
Ex 4amp multi resistance

How to find amps Irotal R divide ohms

Electronic Resistors A resistor is a two terminal electrical component that provides electrical resistance to reduce the flow of current and regulate the flow of electricity. Resistance is expressed in ohms (Ω) or thousands of ohms called kilo ohms (kΩ). Resistors are used for many purposes such as dividing voltages, generating heat and many others

Electricity (Gas) Electrical Safety

How dangerous an exposure to electric shock can be is dependent on several variables including:

- Current flow – higher current increases the severity of shock.

- Voltage and body resistance – increased voltage means a decrease in the resistance of the body to current flow, thus increasing current flow.

- Pathway through the body and the length of time that the current flows through the body.

One difficulty in establishing exact conditions for electrical safety is that voltage can produce different results depending on the circumstances. For example, with 120 V of common voltage under dry conditions, your body resistance may be 100,000 Ohms. The current flow would be calculated as: I = E R = 120 V 100,000 Ω = 0.0012 A (1.2 mA) A current of 1.2 mA might produce a slight tingle. But if conditions are wet or you are perspiring due to vigorous exercise, your resistance may be as low as 1,000 ohms. Then, the current would be: I = 120 V 1,000 Ω = 0.12 A (120 mA)

Electricity (Gas) Residential Electricity

The electrical code requires that all connections to circuits be made only in outlet or junction boxes. The electrical connections fall into two basic groups: • Solderless terminals and insulators • Soldered connections

Electricity (Gas) Single Phase Motors

Torque Torque is the measure of the force that can cause an object to rotate. The more torque a motor produces the more work it can do. The torque output of a motor is the amount of rotational force that the motor develops and is measured in Newton -meters (Nm). The torque and speed relationship are inversely proportional since the rated output power of a motor is a fixed value. As output speed increases, the available output torque decreases proportionately. The same holds true if the output speed decreases, the available output torque increases proportionately

1 watt is equal to 1 volt multiplied by 1 amp. Watts = Volts x Amps

A joule is the unit of energy in the International System of Units (SI system). It is the amount of heat produced when one amp passes through one ohm of resistance in one second.

Horsepower is a measurement of power. It was developed to determine the amount of work done by a horse. It was later applied to measure work done by a mechanical machine, Work is the force times the distance and power is how quickly you are doing that work. It was determined that one horse could lift 330lbs/100ft/min or (55Olbs/ft/sec) which is equivalent to 750 watts of power or 1.0 horsepower in the international system (SI) and the heat equivalent of 2550BTUs (British thermal units) or 4500 kilograms/meters /minut

E**lectrical Energy & Power Electrical** energy is the result of a flow of electrical charges. This electric energy has the ability to do work. In an electrical motor the energy is transferred to the rotor shaft to produce mechanical motion to do work. During this process energy is lost through friction and heat. When an electrical current is passed through a conductor (even a great conductor) it faces a certain amount of resistance. The loss of energy can be calculated when considering the resistance and the current (electron flow). E**fficiency** Electric motor efficiency is the portion of electrical energy input that is not converted to mechanical power but is converted to heat. Efficiency is defined as the output of the motor (power available at the shaft) divided by the supply input to the motor (power available at the source).

An electric motor is a machine capable of converting electrical energy into mechanical energy. The induction motor is the most widely used electric motor because it combines all the advantages offered by the electrical energy such as low cost, ease of supply and distribution, clean handling, and simplicity. Two main types of electric motors are:

- Alternating current motors
- Direct current motors

Most electric motors consist of the same basic construction. They contain 2 main parts a stator (typically made up of wire windings and a ferrous metal where electrical current is applied) and a rotor (usually in the middle of the stator and is free to rotate).

Appliance

Which of the following gas-fired appliances could be used to heat domestic hot water ?

The correct answers are: Storage type water heater, On demand/wall hung water heater, Indirectly heated with a boiler in conjunction with a storage tank

What is meant by the term underfired when referring to storage-type hot water tanks?

The burner is located under the storage tank

What is meant by the term recovery rate when discussing storage-type hot water tanks?

he correct answer is: The maximum amount of hot water that a tank can produce per hour at a given temperature rise.

What are the three basic principles behind a Flammable Vapor Ignition Resistant (FVIR) system ?

The correct answers are: A one way intake system to control the intake of air, A flame arrestor plate, A sealed burner compartment doo

Which of the following best describes a Thermal Cut-Off (TCO).

The correct answer is: A TCO de-energizes the gas valve if excessive temperatures are experienced in the combustion chamber.

Which two types of ignition systems are typically used with power vented hot water tanks?

The correct answers are: Intermittent Pilot , Direct Ignition

What other terms are sometimes used to describe a tankless domestic hot water heater ?

The correct answers are: On-Demand, Wall Hung Water Heater, Instantaneous

What are the three styles of tankless water heaters available based on venting and air supply?

Select one or more:
a.
Outdoor

b.
Indoor, direct vent

c.
Indoor, non direct vent

Put the following firing sequence in order for a tankless water heater.

1. [The circuit board monitors the inlet and outlet water temperatures]

2. [The ventor fan is energized and does a pre-purge]

3. [The pressure switch proves]

4. [The igniter is energized]

5. [The modulating control opens to low fire]

6. [The flame rod proves ignition]

7. [The igniter is de-energized]

Which formula is used to determine the flow rate through a tankless water heater?

\Your answer is correct.

The correct answer is: FlowRate=BtuhChangeinTempx500$FlowRate=BtuhChangeinTempx500$

What is meant by the term “Cold Water Sandwich” when referring to tankless water heaters?

Your answer is correct.

The correct answer is: The fixture receives hot water, cold water and then hot water

How many US gallons per minute could be provided by a tankless water heater with an input of 199,000 Btuh and is 81% efficient; if the cold water supply temperature is 50°F and the outlet temperature is set to 110°F?

199,000 Btuh x 81% = 161,190 Btuh

Flow rate = 161,190Btuh60F×500$161,190 Btuh 60F \times 500$
Flow rate = 5.37 GPM

The correct answer is: 5.37

List the three major differences between a conventional (low efficiency) furnace and a standard (mid-efficient) furnace?

ou have correctly selected 2.
The correct answers are: Heat Exchanger, Burner Ignition, Draft Control

List three operations of a control module on a standard (mid-efficient) furnace?

The correct answers are: Initiate the ignition sequence, control the run cycle, perform the shutdown sequence